(12) UK Patent Application (19) GB (11) 2 171 024 A

(43) Application published 20 Aug 1986

(21) Application No 8602938

(22) Date of filing 6 Feb 1986

(30) Priority data
(31) 702012 (32) 15 Feb 1985 (33) US

(71) Applicant
Filtertek Inc (USA–Delaware),
Price Road, Hebron, Illinois 60034, United States of America

(72) Inventor
Thomas A Cain

(74) Agent and/or Address for Service
Haseltine Lake & Co,
Hazlitt House, 28 Southampton Buildings, Chancery Lane, London WC2A 1AT

(51) INT CL⁴
B01D 29/24

(52) Domestic classification (Edition H):
B1D 1512 1806 1819 1821 1903 1905 1909 2002 2006 2305 2308 KA UX
U1S 1997 2015 B1D

(56) Documents cited
GB A 2115484 GB 1442842 GB 1274712
GB 1519287 GB 1430825 US 3667603
GB 1456934

(58) Field of search
B1D
Selected US specifications from IPC sub-class B01D

(54) Fluid filter

(57) A filter for the transmission fluid in an automobile comprises an elongate housing 20 with a longitudinal inlet 22, an end outlet 24 and an opposite end closure 26 which forms a removable part of the wall of the fluid sump pan 5. The outlet 24 makes a demountable seal with wall 7, separating the inlet side of the pan from a zone connected to a suction pump. The housing encloses two concentric-tubular filter elements 34, 44 and an end filter element 45, all acting in parallel and made of polyester mesh. In Fig. 8 (not shown) the end filter element is extended axially within the other two elements.

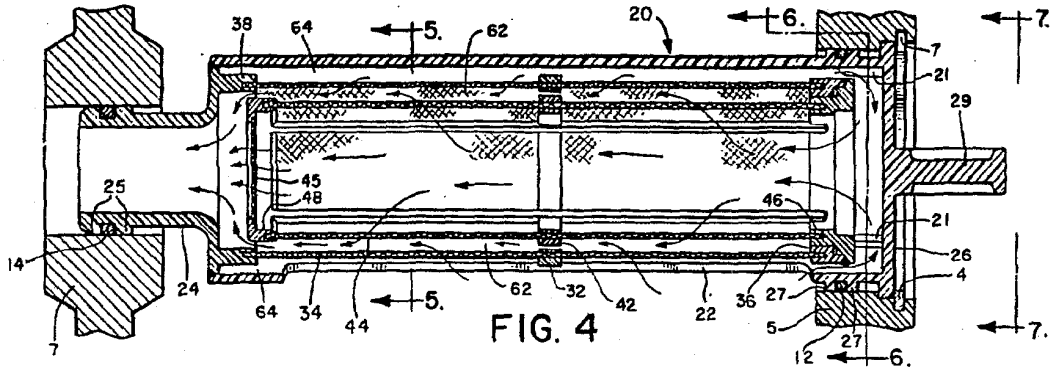

FIG. 4

GB 2 171 024 A

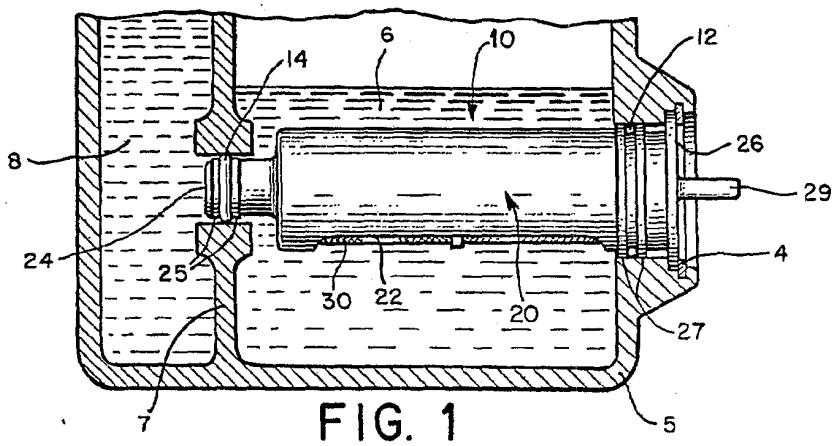

FIG. 1

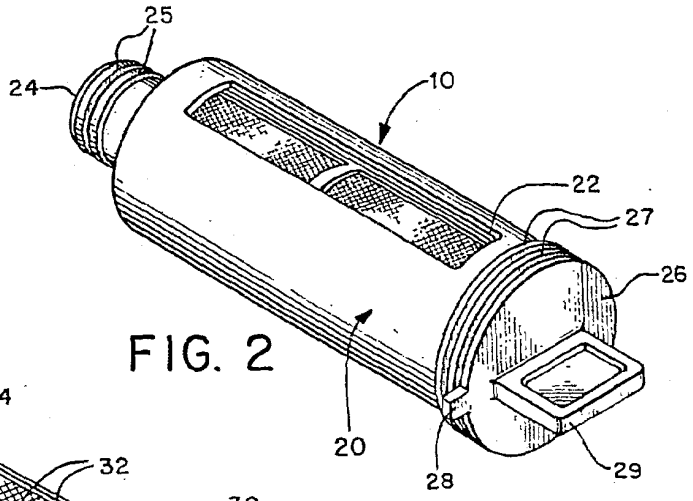

FIG. 2

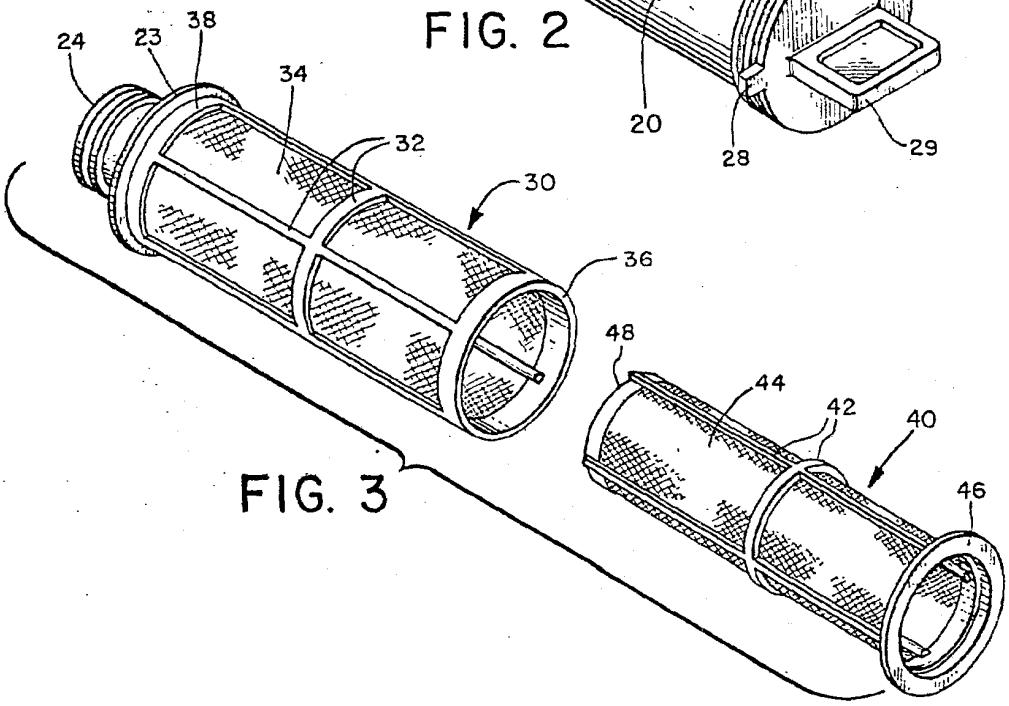

FIG. 3

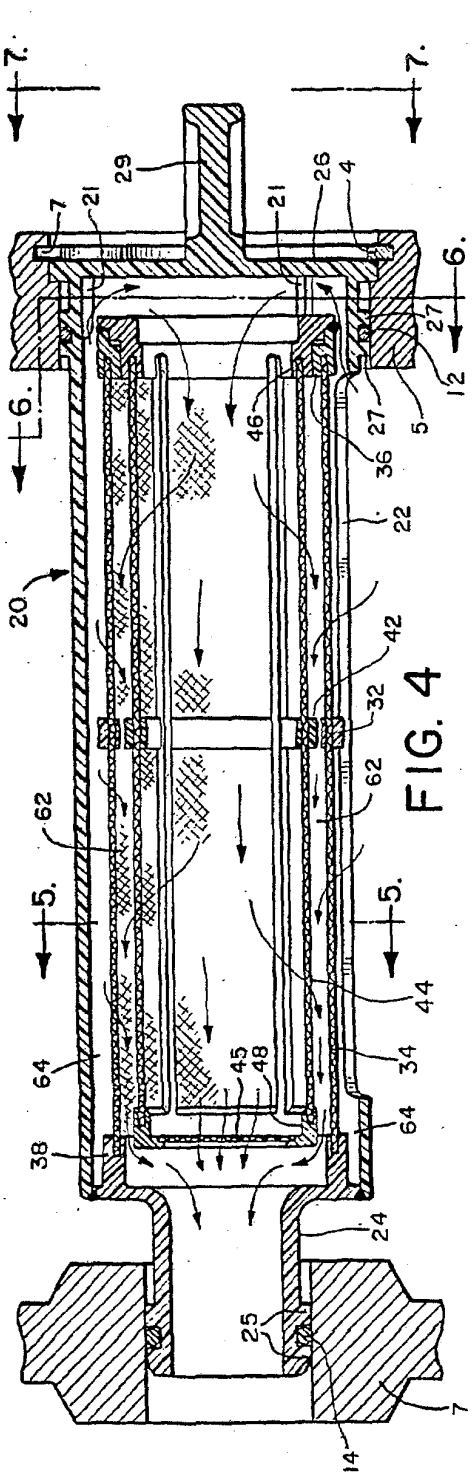

FIG. 4

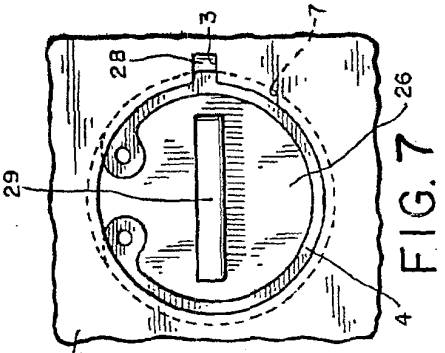

FIG. 7

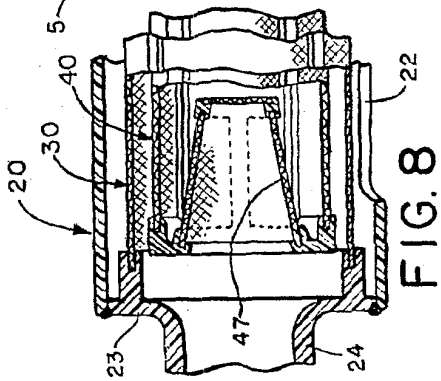

FIG. 8

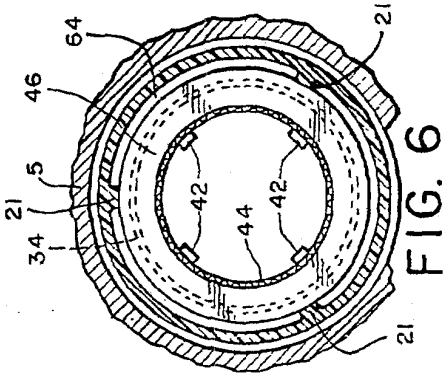

FIG. 6

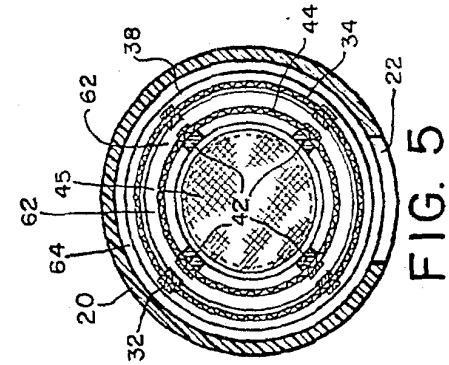

FIG. 5

SPECIFICATION

Easily replaceable fluid filter

BACKGROUND OF THE INVENTION

This invention relates to fluid filters, and more particularly to an easily replaceable automatic transmission fluid filter.

It has heretofore been known to provide a filter in an automatic transmission fluid circulating system to remove particles from the circulating fluid which might damage the system. The fluid circulating system is comprised of the fluid system of the transmission itself, a sump into which fluid collects after passing through the transmission, and a fluid pump, which provides the necessary pressure and circulates the fluid through the system. The suction inlet of the pump is connected to the sump.

Traditionally, filters, such as the one described in U.S. Patent No. 4,136,011 to Joseph et al. have been provided on the suction side of the transmission fluid pump. Traditional filters have been designed for placement inside the circulating system housing in such a manner that it is necessary to remove the transmission fluid sump pan in order to gain access to or change the filter. As a result, it is a difficult and time consuming job to change the transmission fluid filter. In order to avoid the need for changing the filter frequently, it is necessary to either reduce the filter's effectiveness or provide extra filtration surface area to prevent the filter from getting clogged in a shorter period of time than is desired between filter changes.

An easily replaceable automatic transmission fluid filter is desirable, but its design encounters numerous difficulties. First, if it is going to protect the pump from damage caused by impurities in the fluid, the filter must be positioned on the suction side of the pump. The only practical position for the filter is inside the sump housing. If the filter is to be independently removable from the sump housing, there must be a means of sealing the system at the junction between the filter and the outside of the system. In addition, there must also be a means of sealing the suction inlet of the pump from the sump except for the flow path through the filter. These two seals must be easily accessible and replaceable if the easy replacement of the filter itself is to be of any advantage.

Another difficulty encountered in designing a filter is to make sure that no air enters the suction side of the pump through the filter, even during violent maneuvers of the automobile. Air entry into the pump can cause complete destruction of the transmission caused by lack of fluid pressure to critical components. In addition, the filter must withstand a variety of operating conditions, such as temperatures ranging from −40°F to 300°F. It also must contain adequate filter surface for necessary fluid flows at low temperature and to prevent premature clogging of the filter. This is particularly true of applications involving new automatic transmissions with sensitive valve control features requiring very good particulate protection. Because automatic transmissions are made as small as possible, it is also necessary to provide this filtration surface in the small space available for the filter in the sump housing.

SUMMARY OF THE INVENTION

A fluid filter assembly has been invented which is easily replaceable. To this end, the assembly is comprised of a filtration cartridge which can be independently removed from the fluid circulating sump housing. The sump housing is formed with an opening through which the cartridge is inserted. When inserted, a portion of the cartridge itself serves as the remaining outside portion of the sump housing.

The cartridge has means associated and replaceable with it which seal the housing and cartridge, preventing leaks from the system, and means for sealing the sump housing from the pump suction inlet, except for fluid passing through the cartridge. The cartridge contains a plurality of filter members and internal flow channelling structure to assure that the fluid passing through the cartridge is filtered.

The invention, when used in conjunction with an automobile automatic transmission, makes it possible to change the transmission filter without removing the sump pan. The filtration cartridge itself is placed in the sump of the fluid circulating system, thus providing filtration on the suction side of the pump. The cartridge design allows for easy replacement of the filter and the necessary seals between the sump and the pump inlet and between the sump housing and the outside of the transmission fluid circulating system.

The preferred embodiment of the invention uses two concentric cylindrical filter members and parallel filtration flow paths. This allows for adequate filtration surface in the small space available. The cartridge inlet is designed with an opening at the bottom to assure that the opening is always submerged in the fluid in the bottom of the sump. These and other advantages, as well as the invention itself, will best be understood by referring to the detailed description of the preferred embodiment and the following drawings.

BRIEF DESCRIPTION OF THE DRAWINGS.

Figure 1 is a view of a filtration cartridge of the preferred embodiment of the invention shown in place with a sectional view of the transmission sump housing.

Figure 2 is a perspective view of the filtration cartridge of Fig. 1.

Figure 3 is an exploded perspective view of

the filter members inside the cartridge of Fig. 2.

Figure 4 is an enlarged sectional view of the filtration cartridge of Fig. 1.

Figure 5 is a sectional view taken along line 5–5 of Fig. 4.

Figure 6 is a sectional view taken along line 6–6 of Fig. 4.

Figure 7 is an end view taken along line 7–7 of Fig. 4.

Figure 8 is a sectional perspective view of an alternate embodiment of the structure of the inside filter member of the cartridge of Fig. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A portion of a fluid circulating system, such as an automatic transmission housing sump pan 5, is depicted in Fig. 1. The preferred embodiment of the invention is shown as a fluid filter assembly including a filtration cartridge 10 and O-ring seals 12 and 14. The cartridge 10 is positioned so that the fluid inlet 22 remains submerged in fluid 6. An automatic transmission pump (not shown) is in fluid communication with the outlet side of the filtration cartridge 10 so that fluid 6 is drawn out of the sump pan 5, through the filter, and into the pump inlet area 8. The filtration cartridge 10 is comprised of a housing and two internal filter members. The housing includes a cylindrical body 20 with a fluid inlet opening 22 and a circular retaining end 26.

Fig. 2 shows the cartridge 10 from a different viewpoint, clearly showing the opening 22 in the cylindrical body 20, and showing portions of the internal structure of the cartridge 10. Fig. 3 shows an exploded view of the two cylindrical filter members 30 and 40 which nest one inside the other and both inside the cylindrical body 20 of the filtration cartridge housing.

The fluid inlet opening 22 is in the form of a longitudinally extending hole, covering almost the entire length of the body 20. Circumferentially, however, the opening 22 covers only a short arc. In the preferred embodiment the opening 22 covers an arc of about 45°. When properly positioned, the opening 22 provides an inlet into the filtration cartridge 10 only at points near the bottom of the sump pan. In this manner, even when a car is traveling on uneven terrain or turning sharp corners, it is very unlikely that the opening 22 would allow air, rather than transmission fluid 6, to be sucked from the sump housing 5.

As can be seen from Fig. 1, the circular retaining end 26 serves as a portion of the sump housing 5 when the cartridge 10 is in place. An O-ring 12 is placed around the body 20 near the circular retaining end 26 to form a seal between the transmission sump pan and the circular retaining end 26. This seal serves as a means for preventing fluid from escaping from the fluid circulating system between the section of the filtration cartridge serving as the portion of the sump housing and the remainder of the sump housing 5.

A handle 29 is connected to the circular retaining end 26 to provide an easily accessible hand hold for removing the filtration cartridge 10 from the sump housing 5. As shown in Fig. 7, a locating tab 28 on the outside of the circular retaining end 26 is designed to fit within a groove 3 in the sump housing 5. The locating tab 28 serves as indicia allowing identification, from the outside of the transmission, of the position of the opening 22 relative to the bottom of the transmission sump pan 5. The groove 3 cooperates with the tab 28 to assure proper installation of the filter 10 and also helps maintain the proper position.

The opening in the sump housing through which the cartridge 10 can be removed is designed to accommodate a snap ring 4 to keep the filter 10 in place. The snap ring 4 seats itself within a slot 7 formed within the sump housing 5, and blocks the filter cartridge 10 from moving axially while the snap ring 4 is in place.

The cartridge 10 also includes a flanged, circular outlet end 23 having an attached outlet tube 24. The flanged outlet end 23 is formed as part of the outside filtration member 30, as can be seen in Fig. 3, and is connected to the body 20 when the cartridge 10 is assembled. The annular fluid outlet tube 24 provides an exit through which fluid 6 leaves the filter cartridge 10 and enters the pump inlet area 8. An O-ring seal 14 positioned on the outlet tube 24 forms a seal between the transmission sump pan wall 7 and the outlet tube 24. This seal serves as a means for assuring that all fluid circulating through the fluid circulating system passes through the filtration cartridge 10. O-ring 14 is retained by the flanges 25 on the outlet tube 24 and O-ring 12 is retained by the flanges 27 on the body 20 so that when the cartridge 10 is removed from the sump housing and replaced, the O-ring seals are likewise removed and replaced.

As shown in Fig. 4, a first cylindrical filter member 30 is concentrically positioned within the cartridge housing 20. A second cylindrical filter member 40 is concentrically positioned inside filter member 30.

Filter member 30 (Fig. 3) includes structural ribs 32 to support filtration material 34 and hold the material 34 in a cylindrical shape. Filter member 30 also includes two end ribs 36 and 38. Filter member 30 has filtration material 34 covering only its circumference. End rib 36 provides a support end to which filter member 40 is connected when the cartridge is assembled. Rib 38 is attached to the flanged outlet end 23.

Filter member 40 also has filtration material 44 covering its circumference, and ribs 42 and end ribs 46 and 48 to maintain its cylindrical shape. Unlike filter member 30, however, filter member 40 also includes an end filter element 45 positioned across end rib 48. The other end of filter member 40, however, is open.

Three projections 21, 180° apart on the inside of body 20 near the circular retaining end 26 (see Figs. 4 and 6), help keep filter member 30 centered within the housing 20. The other end of filter member 30 is held in place when the flange comprising outlet end 23 is connected to the body 20. The support end of filter member 30, rib 36, supports and holds in place filter member 40 when ribs 36 and 46 are connected. Rib 46 is flanged larger than the diameter of the main portion of filter member 40. Ribs 42 barely fit inside of ribs 32, 36 and 38, which also helps maintain filter member 40 in its concentric position within filter member 30.

When the cartridge 10 is assembled, the filter members 30 and 40 form a pair of filter members with an annular free space 62 between them. In the assembled filter, the free space 62 is sealed at the retaining end by the junction of end ribs 36 and 46. (See Fig. 6) The other end of free space 62, however, is open to the outlet tube 24, because rib 48 is of a smaller outside diameter than the inside of rib 38 and filter member 40 is shorter than filter member 30. (See Fig. 4) Thus free space 62 defines a flow path to the outlet of the cartridge 10 once fluid enters into free space 62.

The end ribs 36, 38, 46 and 48 cooperate with the housing 20 to form an internal structure requiring fluid passing through the cartridge 10 to pass through the filtration material. The end ribs 36, 38, 46 and 48 thus serve a dual function, forming part of the flow path defining means, as well as supporting the filtration material 34 and 44. Once fluid enters the cartridge through opening 22, it may flow freely throughout the annular free space 64 between the body 20 and the first cylindrical filter member 30. In addition, it may freely flow into the inside of the second cylindrical filter member 40 because filter member 30 is shorter than the body 20. From either of these positions, however, the fluid must pass through filtration material before it can reach the outlet tube 24.

As seen in the Fig. 4, the fluid filtering flow path includes three alternate routes: from the outside of member 30 into the free space 62, from the inside of member 40 into the free space 62, and from the inside of member 40 through the end filter element 45. As previously mentioned, fluid from the free space 62 may pass uninhibited to the outlet tube 24. Also, fluid passing through end filter element 45 passes directly to the outlet tube 24.

The filtration material of the preferred embodiment is a woven fabric of polyester monofilaments, with a weave of about 200 threads per inch. This material is sufficient to retain particles of 80 microns or larger. The rest of the cartridge is made of nylon 6/6 30% glass filled. The filtration material is held in place by being molded into the ribs as filter members 30 and 40 are formed by conventional insert molding techniques. The cartridge 10 is assembled by sonic welding end ribs 36 and 46 together and flanged outlet end 23 and body 20 together.

In the preferred embodiment, the filtration material 34 and 44 is the same. However, different filtration capacity materials could be used for each filter member, so long as sufficient flow rates are provided at low fluid temperatures through the least restrictive filter member. As the fluid temperature increases, greater filtering would be provided as the fluid was able to flow through the more restrictive filter members as well.

The present invention provides an easily replaceable automatic transmission filter. The cartridge of the present invention makes it possible to use filtration material with small particle retention because the cartridge can be easily replaced. The O-ring seals 12 and 14 are replaced with the cartridge 10.

The structure of the preferred embodiment provides a large amount of filtration surface area in a small volume. For example, in one model of the preferred embodiment with an outside body diameter of about 1.75 inches and a length of about 5.5 inches, the two filter members together include more than about 28 square inches of filtration surface. If additional filtration surface is desired, the end filter element 45 can be changed, such as to the conical shaped element 47 depicted in Fig. 8. The preferred embodiment uses two cylindrical filter members. However, a greater number of filter members could be used to further increase the filtration surface area.

Another advantage of the preferred embodiment of the invention is the ease with which it can be produced. The cartridge is assembled from only three easily manufactured pieces. The small number of pieces makes assembly not only simple, but reduces the chance of internal leaks.

While the preferred embodiment of the invention has been disclosed, it is understood that the invention is not limited to the preferred embodiment. Modifications in addition to those discussed will be apparent to those skilled in the art and can be made without departing from the spirit of the invention. The scope of the invention is indicated in the appended claims, and all changes that come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

CLAIMS

1. A fluid filter assembly, in part comprising an independently replaceable portion of a fluid circulating system sump housing, comprising:

(a) a filtration cartridge comprising:

(i) a fluid inlet,

(ii) a fluid outlet,

(iii) a plurality of filter members positioned inside one another and each supporting filtration material,

(iv) flow path defining means which channel fluid passing between the inlet and the outlet through the filtration material of at least one of the filter members and

(v) a section serving as the portion of the sump housing;

(b) means for preventing fluid from escaping from the fluid circulating system between the section of the filtration cartridge serving as the portion of the sump housing and the remainder of the sump housing; and

(c) means for assuring that all fluid circulating through the fluid circulation system passes through the filtration cartridge.

2. The assembly of claim 1 wherein the fluid outlet comprises an annular outlet tube and wherein the assuring means comprises an O-ring seal positioned on the outlet tube.

3. The assembly of claim 1 wherein the cartridge section serving as the portion of the sump housing is circular in cross section and wherein the preventing means comprises an O-ring seal positioned between the cartridge section serving as the portion of the sump housing and the remainder of the housing.

4. The assembly of claim 1 wherein the plurality of filter members comprises a first and a second cylindrical filter member; said second filter member being concentrically positioned inside said first filter member and forming an annular free space therebetween.

5. The assembly of claim 4 wherein

(a) the second filter member further includes an end filter element;

(b) the flow path defining means cooperate with the filter members to

(i) provide a flow path from the inlet to both the outside of said first filter member and the inside of said second filter member,

(ii) seal one end of the annular free space between the first and second filter members, and

(iii) provide a flow path from both the annular free space and the end filter element to the outlet; and

(c) whereby fluid passing between the inlet and the outlet passes either

(i) into the annular free space from the outside of the first filter member,

(ii) into the annular free space from the inside of the second filter member, or

(iii) through the end filter element from the inside of the second filter member.

6. The assembly of claim 1 wherein the filtration material supported by each filter member has similar filtration capability.

7. The assembly of claim 6 wherein the filtration material is a woven polyester monofilament material and retains particles of 80 micron size or larger.

8. The assembly of claim 7 wherein the filtration material weave has approximately 200 threads per inch.

9. The assembly of claim 1 wherein the filtration material supported by the plurality of filter members comprises a plurality of materials of different filtration capability.

10. A filtration cartridge comprising:

(a) a housing comprising:

(i) a cylindrical body with a longitudinally extending inlet hole in the periphery of the body,

(ii) a retaining end sealing one end of the body, and

(iii) an open outlet end;

(b) a first cylindrical filter member concentrically positioned with the housing comprising:

(i) filtration material supported by ribs spaced about the cylindrical periphery of the first filter member,

(ii) a flanged outlet end,

(iii) an open support end, and

(iv) an outlet tube connected to the flanged outlet end;

(c) a second cylindrical filter member concentrically positioned within the first cylindrical filter member comprising:

(i) filtration material supported by ribs spaced about the cylindrical periphery of the second filter member,

(ii) an open, flanged inlet end and

(iii) an outlet end supporting filtration material defining an end filter element, and

(d) wherein the body and the first filter member define a first annular free space therebetween and the flange connected to the outlet end of the first filter member cooperates with the body of the housing to seal the end of the first annular free space nearest the outlet tube and

(e) wherein the first and second filter members define a second annular free space therebetween and the support end of the first filter member cooperates with the flange of the inlet end of the second filter member to seal the end of the second annular free space furthest from the outlet tube.

11. The cartridge of claim 10 wherein fluid entering the cartridge through the inlet hole of the body is free to pass into the first annular free space and the inside of the second filter member but must pass through filtration material to enter the second annular free space and must pass through either the end filter element of the second filter member or the second annular-free space to reach the outlet tube.

12. A filter for use in an automatic transmission fluid circulating system on the

suction inlet side of a pump, said filter being capable of independent removal from the transmission fluid circulating system and comprising:

(a) a housing comprising

(i) a cylindrical body with a fluid inlet opening;

(ii) a circular outlet end having an attached outlet tube;

(iii) a circular retaining end;

(b) a first cylindrical filter member positioned within the body;

(c) a second cylindrical filter member positioned within the first filter member and having an end filter element covering the end nearest the outlet tube;

(d) wherein the second filter member cooperates with the first filter member to form an annular free space therebetween; and

(e) wherein the body and the filter members cooperate to form a fluid filtering flow path between the fluid inlet opening and the outlet tube, said flow path passing through one of either of

(i) the first filter member,

(ii) the second filter member or

(iii) the end filter element.

13. The filter of claim 12 further comprising:

(a) means for forming a seal between a transmission sump pan and the circular retaining end to prevent fluid from leaking out of the automatic transmission fluid circulating system and

(b) means for forming a seal between the transmission sump pan and the outlet tube to prevent fluid from passing to the automatic transmission pump suction inlet except through the fluid filtering flow path.

14. The filter of claim 12 wherein the end filter element is circular.

15. The filter of claim 12 wherein the end filter element is conical.

16. The filter of claim 12 wherein the fluid inlet opening comprises a longitudinally extending hole in the periphery of the body circumferentially open over a short arc of the filter housing.

17. The filter of claim 12 wherein the circular retaining end further comprises indicia allowing identification from the outside of the transmission of the position of the fluid inlet opening relative to the bottom of the transmission sump pan.

18. The filter of claim 12 wherein the circular retaining end further comprises a handle.

19. A filtration cartridge substantially as hereinbefore described with reference to, and as illustrated in, Figs. 1 to 7 of the accompanying drawings.

20. A filtration cartridge substantially as hereinbefore described with reference to, and as illustrated in, Figs. 1 to 3 and 5 to 8 of the accompanying drawings.

Printed in the United Kingdom for
Her Majesty's Stationery Office, Dd 8818935, 1986, 4235.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.